REMARKS

In view of the above amendments and following remarks, reconsideration and further examination are requested.

Initially, a replacement formal drawing for Figure 2 has been provided which correctly identifies the lower edge of the upper cylindrical portion with reference numeral -- 40--.

The specification has been reviewed and revised to make editorial changes thereto and generally improve the form thereof, and a substitute specification is provided. No new matter has been added by the substitute specification. The substitute specification is believed to be in compliance with 37 CFR § 1.77(b), and the objection noted by the Examiner in section 1 on page 2 of the Office Action has been addressed by the substitute specification. Also, an abstract has been provided.

The Examiner rejected claims 1-32 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention, and indicated that these claims would be allowable if rewritten or amended to overcome the rejections under 35 U.S.C. § 112, second paragraph.

Accordingly, by the instant Amendment, claims 1-32 have been cancelled and claims 33-64 have been added. Please see the following table for correspondence between new claims 33-64 and former claims 1-32.

New Claims	Former Claims
33	1
34	2
35	3
36	6
37	26
38	8
39	11
40	17

41	32
51	4
52	10
53	16
54	31
56	12
55	24
57	27
59	5
60	14
61	29
62	22
46	9
47	15
48	30
44	13
43	21
45	28
42	25
58	20
49	23
50	19
63	18
64	7

Claims 33-64 have been drafted taking into account the 35 U.S.C. § 112, second paragraph, issues raised by the Examiner, are believed to be free of these issues, and are otherwise believed to be in compliance with 35 U.S.C. § 112, second paragraph.

With regard to new claims 38 and 51, please note that these claims differ from former claims 8 and 4, respectively, by correctly reciting that the upper cylindrical portion is --not able-- to plug the through-bore when the plunger piston is in contact with the first frusto-conical crown-like ring.

In view of the above amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and an early Notice of Allowance is earnestly solicited.

If after reviewing this Amendment, the Examiner believes that any issues remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the Applicant's undersigned representative by telephone to resolve such issues.

Respectfully submitted,

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October 7, 2003

HYDRAULIC PRESS APPARATUS WITH IMPROVED CONTROL OF ~~THE~~ AN OLEO-DYNAMIC CIRCUIT THEREOF

~~DESCRIPTION~~BACKGROUND OF THE INVENTION

The present invention pertains~~refers~~ to a vertical hydraulic press apparatus adapted to most efficiently and effectively cause complementary half-~~moulds~~ molds to clamp together in both, processes used to form metal materials and~~, in particular, in~~ processes aimed at injection-~~moulding~~ molding and forming thermoplastic materials.

A very wide variety and types of hydraulic press apparatuses are largely known to be currently available and in practical use. ~~Anyway, i~~It can be easily noticed that ~~the~~ simplicity in ~~the~~ overall construction of such machines, and an ~~as~~ easy and effective as possible control of ~~the~~ operations thereof are among the most common requirements that engineers tend to comply with when designing these presses.

~~The~~ A basic schematic layout of a hydraulic press apparatus used for clamping half-~~moulds~~ molds ~~in~~ during injection-~~moulding~~ molding processes for forming thermoplastic materials generally includes a guide column associated ~~to~~ with a piston adapted to slide within a hydraulic cylinder. When ~~the~~ an upper half-~~mould~~ mold is moved vertically with respect to ~~the~~ a stationary lower half-~~mould~~mold, ~~the~~ hydraulic fluid that finds itself on a side of the piston is partially transferred, owing to ~~the~~ displacement of the piston itself, to ~~the other~~another side of the piston through an external circuit and at least a controlled valve.

~~The p~~Presence of such an external circuit, however, implies ~~the~~ installation of a number of mechanical component parts, and further requires ~~a lot of~~many precision machining operations to be performed. Such a need, along with ~~the requirement~~ requirements for ~~said~~ the valve and ~~the~~ related control circuits ~~to be so provided~~, makes ~~the~~ construction of such a press apparatus particularly complicated, expensive and demanding, and also quite delicate in its operation.

~~US-A~~United States Patent No. 5,204,047 and ~~US-A~~United States Patent No. 5,302,108 are known to teach a method for making a particular type of hydraulic press apparatus using a support column for ~~said~~ pistons so as to minimize ~~the~~ overall space requirements of the press apparatus, wherein ~~the~~ peculiarity of this press apparatus lies in its being provided with a plurality of pistons associated ~~to~~ with a stationary differential piston.

Although ~~the~~ a main purpose of ~~said~~ the above two patents is actually reached with such a solution, ~~also~~ the ~~so obtained~~ press apparatus of these patents ~~, however, turns out as being~~ is too complicated and expensive in its construction and delicate in its operation because of, ~~owing~~ particularly, ~~to the really~~ a large number of hydraulic conduits that need to be closed and opened in a synchronized pattern.

BRIEF SUMMARY OF THE INVENTION

It is therefore a main purpose of the present invention to provide a vertical hydraulic press apparatus, particularly adapted for use in connection with plastic ~~moulding~~ molding processes, which apparatus is compact, reliable in its operation, uses low-cost materials, construction requirements and component parts, and has a simple and reliable construction based on ~~the~~ use of readily available techniques.

Such a type of press apparatus is obtained and implemented with ~~the~~ features that are substantially described with particular reference to the appended claims.

~~Anyway, f~~Features and advantages of the present invention can more readily be understood from ~~the~~ a description that is given below by way of a non-limiting example with reference to ~~the~~ accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

- Figures 1 through to 11 are schematical, vertical-section views of a press apparatus according to the present invention, during ~~as many~~ successive operating phases thereof~~;~~.

Figure 1 shows a first phase of operation the press apparatus according to the present invention;

Figure 2 shows a second phase of operation the press apparatus according to the present invention;

Figure 3 shows a third phase of operation the press apparatus according to the present invention;

Figure 4 shows a fourth phase of operation the press apparatus according to the present invention;

Figure 5 shows a fifth phase of operation the press apparatus according to the present invention;

Figure 6 shows a sixth phase of operation the press apparatus according to the present invention;

Figure 7 shows a seventh phase of operation the press apparatus according to the present invention;

Figure 8 shows an eighth phase of operation the press apparatus according to the present invention;

Figure 9 shows a ninth phase of operation the press apparatus according to the present invention;

Figure 10 shows a tenth phase of operation the press apparatus according to the present invention;

Figure 11 shows an eleventh phase of operation the press apparatus according to the present invention;

Figure 12 is a cross-sectional view of a plunger piston of the press apparatus; and

Figure 12A is a perspective view of the plunger piston.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the above Figures, the press apparatus according to the present invention comprises:

~~-a~~ a lower plate 1 and an upper plate 2 on which appropriate ~~moulds~~ molds (not shown) are ~~applied~~provided;

~~an~~ an actuation apparatus connected to ~~said~~ the two plates 1, 2, and comprising a cylinder 3, a piston 4 and two conduits 5 and 6 adapted to selectively pump hydraulic fluid into ~~the~~ two volumes of ~~said~~ the cylinder, ~~that~~ which volumes are delimited and separated from each other by ~~said~~ the piston;

~~a~~ a hollow cylinder 7 provided under ~~said~~ the lower plate 1 and arranged with its axis extending vertically, ~~said~~ wherein the cylinder ~~having~~ has its upper edge 8 arranged so as to tightly fit against ~~the~~ a lower surface 9 of ~~said~~ the lower plate 1;

~~a~~ a guide column 10 connected ~~with~~ via an appropriate connection ~~means~~ member 11 to ~~said~~ the upper plate 2, and forming with its lower end portion 12 ~~the~~ a rod of a piston 13 adapted to slide within ~~said~~ the hollow cylinder 7, so that the ~~entire~~ guide column in its entirety is able to be driven to move vertically;

~~a~~ a bore 14 extending throughout ~~said~~ the lower plate and adapted to accommodate ~~said vertically sliding~~the guide column 10 as it moves vertically;

~~an~~ an aperture 15 provided in ~~the~~ a side surface of ~~said~~ the hollow cylinder 7 and adapted to enable ~~the~~ an inner volume 16, which is provided above ~~said~~ the piston, to communicate with an appropriate ~~means~~ member 17 that is adapted to apply a hydraulic pressure into ~~said~~ the inner volume 16 when ~~said~~ the piston 13 is in its lower position.

~~Anyway, w~~What has been ~~just~~ described above ~~belongs~~ corresponds to the state of the art and has only been ~~reminded~~ recited here for reasons of better understanding the present invention.

According to the present invention, ~~said~~ guide column 10 is provided with an inner cylindrical cavity 18 having its axis extending parallelly to ~~the~~ a direction of displacement of the column and opening at ~~the~~ a lower end portion ~~19~~ of the ~~same~~ column.

Inside ~~said~~ the cylindrical cavity 18 ~~there~~ is arranged a sliding piston of ~~the~~ a plunger type, which is formed by an upper cylindrical portion 20 and a lower portion 21.

~~Said~~ The upper cylindrical portion 20 is so sized as to be able to plug ~~said~~ the inner cylindrical cavity 18, while ~~anyway~~ allowing ~~said~~ piston to slide; moreover, the lower portion 21 of the piston is so sized as to extend ~~downwards~~ downwardly by a definite ~~level~~amount, which shall be explained in greater detail ~~further on~~later, with respect to the upper cylindrical portion, and has a width that is smaller than ~~the~~ a width of the upper cylindrical portion ~~itself~~ so that ~~said~~ the lower portion will ~~in no ease~~not be able to interfere with or touch ~~the~~ an inner wall of ~~said~~ the inner cylindrical cavity 18.

~~The~~ A wall of ~~said~~ the guide column 10 is provided, above ~~the~~ a level of the piston 13, with a through-bore 22 that enables ~~said~~ the inner volume 16 to communicate with ~~said~~ the cylindrical cavity 18. It shall of course be appreciated that such a circumstance occurs when ~~said~~ the plunger-type piston is displaced away from ~~said~~ the through-bore, and ~~the~~ a height of the upper cylindrical portion 20 of ~~said~~ the plunger-type piston is furthermore at least equal to ~~the~~ a height of ~~said~~ the through-bore 22, so that ~~said~~ the plunger-type piston is capable, in definite positions thereof, of ~~shutting said~~closing the through-bore, thereby interrupting ~~the~~ connection between ~~said~~ the inner volume 16 and ~~said~~ the cylindrical cavity 18.

~~The d~~Dimensions of ~~the~~ various afore-described members are such that, when the piston 13 and, as a result, also the guide column 10 are displaced ~~in~~ to their lower positions, as ~~this~~ is illustrated in Figures 5 and 6, ~~the~~ an upper portion of the plunger-type piston plugs ~~said~~ the through-bore 22, and when the piston 13 raises to a sufficiently high position, as ~~this~~ is illustrated in Figures 1, 2 and 3, the plunger-type piston, which is a floating piston, remains in a lowered position by ~~the~~ action of gravity and, as a consequence, leaves ~~said~~ the through-bore 22 open.

The operating mode, as anyone skilled in the art is at this point capable of realizing, is as follows:

- In a first phase (Figure 1), the guide column 10, and therefore also the ~~therewith connected~~ piston 13, ~~is~~ are completely raised; hydraulic fluid at an appropriate pressure is ~~let in~~introduced from the conduit 5 of the cylinder 3 so as to cause the two plates 1 and 2 to move closer to each other; the plunger-type or floating piston is in a lowered position with respect to the through-bore 22 which, as a result, is left clear and open so as to enable ~~the~~ oil to flow ~~over~~ from the inner cylindrical cavity 18, whose volume is decreasing gradually ~~owing to~~because of the upper plate 1 being ~~so~~ caused to move ~~downwards~~downwardly, to the inner volume 16 of the cylinder 7.

The floating or plunger type piston does not fall back ~~on~~ to ~~the~~ a bottom of the hollow cylinder 7, but is rather retained within ~~said~~ the inner cylindrical cavity 18 by ~~the~~ action of an inner, preferably frusto-conical, lower crown-like ring 23 which is arranged below ~~said~~ the through-bore 22 and is adapted to stop ~~said~~ the floating piston ~~in~~ at a certain lower position thereof by interference with the upper cylindrical portion 20 thereof.

In an advantageous manner, also ~~the~~ a lower edge 40 of ~~said~~ the upper cylindrical portion 20 is shaped in ~~the~~ a form of a frustum of cone so as to be able to perfectly fit against the frusto-conical shape of ~~said~~ the crown-like ring 23, while ~~the~~ a combination of ~~the~~ a position of ~~said~~ the crown-like ring ~~with the~~and a height of ~~said~~ the upper cylindrical portion of the floating piston is such that, when the ~~latter~~ upper cylindrical portion is brought to rest on ~~said~~ the crown-like ring, ~~said~~ the through-bore 22 remains clear and open.

~~- The next, ie.~~A second phase (Figure 2) may be considered as an intermediate oil transfer phase. Hydraulic fluid ~~keeps being let~~continues to be introduced into the [piston] cylinder 3 from the conduit 5 and this causes the guide column 10 ~~,~~ and the ~~related plunger-type~~ piston 13~~,~~ to move further ~~downwards~~downwardly, while the hydraulic fluid ~~keeps~~ continues flowing ~~over~~ as explained above.

- In ~~the~~ a third phase (Figure 3) the guide column 10 ~~keeps~~ continues lowering until ~~the~~ a lower surface of the lower portion 21 of the plunger-type piston ~~enters~~ comes into contact with ~~the~~ a bottom wall 24 of the hollow cylinder 7.

- In ~~the~~ a fourth phase (Figure 4) the guide column ~~keeps~~ 10 continues moving ~~downwards~~ downwardly and, with it, ~~also~~ the through-bore 22 which therefore moves closer to ~~the~~ a level of the plunger-type piston, ~~that~~ which is prevented from lowering any further ~~by said~~via the lower portion 21 being in contact with the bottom wall 24~~;~~ . ~~said~~ The through-bore ~~starts therefore~~22, accordingly, begins to be plugged.

- In ~~the~~a fifth phase (Figure 5) the guide column ~~keeps~~ 10 continues lowering ~~down~~ to its bottom dead point.

In this position, in which ~~the mould~~a mold (not shown) is fully clamped, the through-bore 22 moves exactly in front of the upper cylindrical portion 20 of the plunger-type piston, which therefore ~~plugs it~~results in the through-bore being plugged by the upper cylindral portion. As a result, any passage of hydraulic fluid towards the inner volume 16 ceases.

In order to prevent even ~~the~~ a ~~smallest~~ amount of hydraulic fluid from being able to seep through ~~said~~ the through-bore 22 into the cylindrical cavity 18 ~~in the next~~during a subsequent compression phase, there is provided a second annular, preferably frusto-conical, crown 25 arranged above ~~said~~ the through-bore 22 and adapted to stop ~~said~~ the floating piston in a definite lower position thereof by interference with the ~~related~~ upper cylindrical portion 20.

In an advantageous manner, ~~also the~~an upper edge 30 of ~~said~~ the upper cylindrical portion 20 is shaped in ~~the~~ a form of a frustum of cone so as to be able to perfectly fit against the frusto-conical shape of ~~said~~ the upper crown-like ring 25, while ~~the~~ a combination of ~~the~~ a position of ~~said~~ the upper crown-like ring with ~~the~~ dimensions and ~~the~~ position of ~~said~~ the upper cylindrical portion of the floating piston

is such that, when the ~~latter~~ floating piston is moved to its top dead point, ~~the~~ mating frusto-conical shapes of the upper crown-like ring 25 and the upper cylindrical portion of the floating piston being ~~so~~ brought to fit against each other actually prevents any hydraulic fluid from seeping through the through-bore 22.

Furthermore, in order to prevent abrupt shocks and excessive pressures between ~~said~~ the mating frusto-conical shapes there is provided an elastic element 27 on the bottom wall 24 of the hollow cylinder 7, which elastic element the lower portion 21 of the plunger-type piston comes to lie against, and which is further capable of absorbing, ~~ie.~~ i.e. taking up, any possible modest interference and/or excessive coupling pressure.

~~The~~A sixth phase of ~~the~~ operation (Figure 6) is ~~the~~ a phase in which ~~the~~ maximum extent of compression of ~~the~~ hydraulic fluid is brought about in view of keeping the ~~mould~~ mold firmly clamped against ~~the~~ expanding pressure of ~~the~~ a part being ~~moulded~~molded, which in fact would tend to cause the ~~same mould~~mold to open ~~apart~~. This compression is brought about by ~~means~~ virtue of per ~~sè~~ se known ~~means~~ member 17 ~~that are~~which is adapted to most quickly set ~~said~~ the inner volume 16 under a high pressure by acting on ~~the~~ hydraulic fluid through ~~said~~ aperture 15 in the wall of the cylinder 7.

~~In~~ During this phase, the floating piston and the guide column 10 do not move, ~~ie.~~ i.e. they ~~stand~~ remain still.

~~The next~~A subsequent seventh phase (Figure 7) corresponds to ~~the~~ an opposite sequence of the sixth phase ~~above~~. In other words, ~~the~~ pressure generated by ~~said means~~the member 17 is released, while the guide column 10 and the ~~floating~~ piston 13 do not ~~move~~ yet move .

- In ~~the next~~a subsequent eighth phase (Figure 8) ~~the~~ hydraulic fluid ~~starts~~ begins to be pumped into the conduit 6 of the cylinder 3, and this causes the upper plate 2, and therefore also the guide column 10, to move ~~again upwards~~ upwardly and ~~the~~

pressure on the elastic ~~means~~ element 27 to be released by the floating piston ~~owing to the~~because of action of ~~also said~~the ~~second~~ upper ~~circular~~ crown-like ring 25 being ~~lifte~~ lifted jointly with the guide column.

- In ~~the~~ a ninth phase (Figure 9) the guide column ~~keeps~~ 10 continues raising, while the lower crown-like ring 23 is raised until it ~~enters~~ comes into contact with the lower edge 40 of the upper cylindrical portion 20 of the floating piston~~,~~; however, without causing the ~~latter~~ floating piston to ~~start~~ begin moving ~~upwards~~ upwardly yet. The through-bore 22 is opened as a result of the guide column 10 being so raised, and ~~the~~ hydraulic fluid within the inner volume 16 is pushed and starts to flow ~~over~~ into ~~said~~ the inner cylindrical cavity 18.

- In ~~the~~ a tenth phase (Figure 10) the guide column ~~still keeps~~10 continues raising so as to cause ~~also~~ the floating piston to rise by pulling it ~~upwards~~ upwardly ~~owing to~~ because of its having so engaged the ~~inner~~ lower crown-like ring 23~~,~~, and ~~the~~ hydraulic fluid ~~keeps~~ continues flowing ~~over~~ into the inner cylindrical cavity 18.

- In ~~the~~ a last, ie. eleventh phase (Figure 11), the press regains a set-up position which is similar to the ~~one~~ position illustrated in Figure 1~~.~~, i.e. the guide column 10 and the upper plate 1 reach ~~the~~ a top dead center under a maximum extent of hydraulic fluid having been caused to flow ~~over by this time~~. From this moment on, a new cycle can therefore ~~start~~ begin from the afore-mentioned ~~cited~~ first phase.

Furthermore, in all Figures 1 through ~~to~~ 11, there can be noticed ~~the~~ presence of a cylindrical member 33 arranged ~~in the form of~~as a plug over ~~the~~ a level of ~~the~~ hydraulic fluid in the cylindrical cavity 18. This cylindrical member 33 ~~has the task of~~functions to preventing any excessive surface vorticity, in particular during ~~the~~ phases in which the through-bore 22 is opened and closed~~; in~~. In view of promoting such a function, ~~the~~ a volume of gas ~~34~~ above ~~said~~ the cylindrical member 33 is ~~kept~~ maintained under a slight pneumatic pressure, preferably through an appropriate conduit 35.

~~The a~~Advantages of the present invention are now quite apparent and may be summarized as follows:

~~–~~(i) smaller space taken up by the press apparatus ~~owing to~~because of ~~the~~ maximum extent of efficiency in using ~~the~~ inner volumes of the guide column 10;

~~–~~(ii) maximum extent of construction and functional simplicity deriving from ~~the~~ elimination of any external hydraulic circuits; and

~~–~~(iii) elimination of ~~the~~ controlled valves, under significant economic advantages deriving ~~also~~ from ~~the~~ elimination of ~~the~~ related control and actuation circuits.

Moreover, a press apparatus according to the present invention can be implemented with ~~the~~ use of materials and techniques that are readily available and fully known in the art, which furthermore show no ~~criticity~~ criticality or difficulty in their utilization.

It shall be appreciated that the description and illustrations given above with reference to the accompanying drawings have been given by mere way of exemplification of the present invention, and that a number of variants and modifications can therefore be introduced thereto without departing from the scope of the present invention.

ABSTRACT OF THE DISCLOSURE

A hydraulic press apparatus comprises: a lower plate and an upper plate adapted to be driven toward the lower plate via operation of a motion a position control device; a hollow cylinder under the lower plate, the hollow cylinder having an upper edge tightly engaged with a lower surface of the lower plate; a guide column connected to the upper plate, the guide column having a lower end portion that defines a rod for a first piston adapted to slide within the hollow cylinder, and the guide column defining an inner cylindrical cavity that extends through the first piston, with the inner cylindrical cavity being filled with hydraulic fluid; a hole extending through the lower plate, the hole being adapted to slidably accommodate said guide column; an aperture in a side surface of the hollow cylinder, the aperture allowing a volume defined between the lower plate and the first piston to communicate with a hydraulic device that is adapted to apply a hydraulic pressure within the volume when the first piston is in a lower position; a plunger piston adapted to slide within the inner cylindrical cavity, the plunger piston including an upper cylindrical portion that has a diameter such that the upper cylindrical portion is capable of plugging the inner cylindrical cavity, the plunger piston also including a lower portion that has a diameter smaller than the diameter of the upper cylindrical portion so as to prevent the lower portion from contacting walls defining the inner cylindrical cavity; and a through-bore allowing the inner cylindrical cavity to communicate with the volume when the upper cylindrical portion is at a level that is beneath a level of the through-bore.